# Agro-ecological intensification in Malawi through action research with smallholder farmers

Africa RISING- ESA Project proposal 2013/14

Michigan State University (MSU)

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Africa RISING- ESA Project 2013/14 Malawi

1. Project Title:

Agro-ecological intensification in Malawi through action research with smallholder farmers

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Research Team composition

| Name | Gender | Institution | Job title | Disciplinary expertise | Highest qualification | Project role/ responsibility | % time commitment |
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| Dr Fanny Chigwa | F | LUANAR | Lecturer | Animal Science | PhD | Livestock intensification | 15 |
| Dr Agness Mwangwela | F | LUANAR | Lecturer | Nutrition and Food Science | PhD | Nutrition and local level food processing | 15 |
| Dr Desta Lulseged &<br>Dr Roland Chirwa | M<br>M | CIAT | Research Scientists | Soils and bean studies | PhD | Beans integration (and soils) | 15 |
| Dr I Nyoka & Dr W. Sileshi &<br>A. Mulwafu | M | ICRAF | Research Scientists | Agroforestry/ livestock feeds | PhD | Livestock intensification | 15<br>15 |
| Mrs A. Msukwa &<br>Mr O. Kumwenda | F<br>M | DAES (Ntcheu and | DADOs | Extension | MSc | Project R4D district platform | 10<br>10 |

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| | | Dedza) | | | | hubs | |
| Dr A. Arega | M | IITA | IITA Country rep | Economist | PhD | Malawi project hosting and general supervision | 5 |

3. Abstract

Low land productivity undermines potential food production, stifles income growth from the lack of surplus food and keeps many farming families impoverished and undernourished. Bearing in mind the wide gaps between potential and current crop yields in Africa, it is clear that increasing agro-ecosystem primary productivity implies the need for intensification of the basic ecological functions of photosynthesis, water capture and nutrient cycling. Biodiversity is one key to such intensification, by allowing for more efficient use of resources in space and time (exploiting complementarities, facilitation) and regulating interactions to control biotic constraints. Current demographic shifts driven by male outmigration to urban centers leave women with the burden of managing most farm and household chores. The purpose of the Michigan State University-led component of the Africa RISING Program in Malawi is to enhance farmer knowledge and support sustainable intensification (SI) pathways for productivity gains in maize-legume diversified systems, that also integrate livestock-related enterprises such as improved fodder for intensified dairy production and goat meat production. In Malawi, strategies that enhance goat production could appeal to a broader group of farmers as goat ownership is more widespread compared to cattle ownership. The main objective of the project is therefore to set up a research approach that systematically assesses SI best-bet options that appropriately respond to the needs of resource-poor farmers - particularly female headed households. Building on the first 2 years of Africa RISING action research activities already undertaken in Dedza and Ntcheu districts, the Year 3 expanded research team will explore opportunities for integrating crop-livestock components through testing various technical options under farmer conditions. During Year 3, we will consolidate activities in Year 2 action villages, and also encompass new village clusters. The number of mother trials will be increased from 8 to 12, while the number of 'baby trial' farmers directly experimenting with SI technologies will more than double from 451 in Year 2 to >900 in Year 3, 1500 in Year 4, and to nearly 2000 by the end of the project (Year 5). Working with IFPRI, Africa RISING Malawi plans to establish the efficacy of intervention strategies by comparing project outcomes from intervention and counterfactual cluster of villages over the project period. As from Year 3, research with climbing beans will be an important component of our activities. Nutrition workshops on local-level processing of grain legumes, will also constitute a significant part of the project activities, as such knowledge can be a pull factor for step-wise increased production. We envisage that farm-scale production strategies employed by different farm/farmer typologies will be further distilled through scenario analyses using farming systems simulation modeling approaches. The project will continue to work with an alliance of actors, (agro-dealers, extension services, NGOs, local government structures, etc) to result in viable R4D platforms anchored at the district level.

4. Research problem and justification

Food insecurity and malnutrition are perennial problems for the majority of rural households in Malawi (Bezner-Kerr, et al., 2010). This is the overriding concern to agricultural scientists and extension educators, yet too often single component technologies are promoted as solutions, and rarely does research address

the resource constraints articulated by farmers. The constraints include inadequate and outdated extension messages, labor limitations, variable rainfall, nutrient deficient and/or degraded soils, and over-reliance on low protein staple crops (Rowhani, et al., 2011; Stoorvogel et al. 1993). Many smallholder farmers in Malawi do not own enough livestock to provide adequate manure for soil fertility replenishment or milk for the much needed nutrition for children. Households largely rely on nutrient-poor staple crops, and have limited knowledge of the essential role that grain legumes play in human nutrition, especially for non-traditional crops such as soyabean, that require some training in appropriate local level processing for production of nutritious foods (Saito et al., 1994).

Sustainable intensification technologies have shown promise, including gains in fertilizer use efficiency, from 50 to 120%, and enhanced stability of yields (Myaka et al., 2006; Snapp et al., 2010). At the core of sustainability is the increased capture of carbon and nitrogen through biological fixation and vegetative cover provided by multi-purpose leguminous plants such as pigeonpea, and long term options with legume trees, such as gliricidia and faidherbia. Some of these species produce grain for human consumption and others forage for improved livestock production, and all have leafy biomass useful for soil fertility building and improving mineral fertilizer efficiency.

There are action-learning and systems approaches that have been proven effective, yet they have rarely been integrated and applied at scale across heterogeneous communities. It is crucial to build local capacity and support adoption of integrated, adaptive management strategies to address the challenges smallholders face and sustainably intensify their agricultural production systems. During Year 2 (2012/13), the Africa RISING Malawi research team adopted the 'mother and baby' based action research approach that has been successfully employed in Northern Malawi (Bezner- Kerr et al., 2006; Snapp et al., 2010). To date, indications from our internal team reflection of the Year 2 research process, and insights from feedback workshops held with the intervention farmers are encouraging as farmers demonstrated new knowledge acquisition. During Year 2, we thus built the basic platform for effective learning, and rapport with diverse farming communities and stakeholders for experimenting with crop-based SI technologies to farmers of diverse resource endowment. In contrast to the first 2 years that had initiatives paying little attention to the livestock component, during Years 3-5, we envisage employing strategies that will improve availability of livestock products, especially goat production and cows for dairy products. Livestock feed is usually a critical bottleneck to intensification, especially for dairy cows that have high demand for high protein feed. Other than activities that will specifically target production of fodder from leguminous tree species, we envisage a synergistic link between the increased production of leguminous crops that will provide quality stover for livestock feed as a pathway for intensification of dairy production.

5. Relevance of proposal to Africa RISING Framework

In line with the overall Africa RISING ideology, the Africa RISING Malawi project aims to work with diverse farmers to sustainably intensify their agricultural enterprises, and enhance livelihoods, using entry points that have practical relevance to the local agro-ecologies. In Dedza and Ntcheu districts, our entry point hinges on harnessing the ecological benefits, nutritional and other direct economic benefits that accrue from intensified grain legume production on the farms, that includes soyabean, groundnut, pigeonpea, cowpeas and climbing beans. We hypothesize that this approach stimulates more closed nutrient cycling and systems productivity, resulting in farmers producing their staple maize more optimally when appropriate crop sequencing and soil nutrient management strategies are adhered to.

We recognize that historically, management recommendations in Africa have generally targeted maximization of yields or profits without consideration of agricultural risks, resource constraints and

priorities of farmers (Snapp et al., 2003; Tenge et al., 2004). Moving into Year 3, this project will test a wider range of technological options across different farms, including targeted fertilizer application and legume-based technologies, and dairy production technologies, that are within the reach of resource poor farm families. Where the agro-ecological conditions permit, introducing climbing beans is perceived to be strategic - they are a good and cheap source of proteins, energy, and carbohydrates. Climbing beans generally have potential for higher yield compared to the dwarf (bush) beans, a trait that is advantageous for highly populated countries such as Malawi, to achieve increased food security levels and reduce poverty amongst farmers. Climbing beans also play a major role in crop rotation and intercropping systems, enhancing the productivity, not only to crops that are planted simultaneously, but also to those that follow.

By the end of Year 3, we would have mobilized, sensitized and directly targeted at least 900 farmers to experiment with different SI technologies, and expose several thousands more households to the technologies through community level activities such as field days and nutrition fares, with associated ripple effects expected to be enormous. We also anticipate realizing an increased participation by agricultural service providers, and other extension systems in learning platforms, which in turn is expected to stimulate increased demand for empirical knowledge. Using appropriately paired intervention-counterfactual research sites, we will be able to track the efficacy of our SI technologies delivery approaches and be more able to enrich the science of technology delivery mechanisms that is over-arching to the Africa RISING research agenda. The baseline survey that has been recently implemented by IFPRI in the intervention and counterfactual sites will provide vital benchmarking statistics upon which evaluation of the project outcomes will be based when the endline survey is implemented during Year 5. In the interim, the research team will employ different socio-economic methods to track technology uptake, including focus group discussions, end of season reflection workshops with action group farmers, and snap surveys on participating and non-participating households to profile food consumption patterns and market participation.

6. Objectives and research questions

The project is guided by the hypothesis that when empirical knowledge on SI is translated into action through participatory action research methods, households are better able to innovate, adapt and adopt technologies. The types of technologies will vary with typology of the households, yet an overall trajectory will prevail for sustainable intensification in crop yield, livestock products and incomes. The chief objective is to build capacity for integrating participatory action research with farmer-oriented learning approaches. This is critical for translating empirical knowledge into SI options for resource conservation and stable agricultural (crop and livestock) productivity gains. The research questions include:

i. What are the current biophysical and socio-economic constraints to increased quality, quantity and diversity of crop (cereals and grain legumes) and livestock products (meat and dairy), especially for women farmers? *(Integration hypothesis, H1)*

ii. How effective are the different technological options under different biophysical and socioeconomic conditions in enhancing food security, nutrition and ecosystem stability? *(Integration hypothesis, H1 & Innovation sequencing and SI pathways hypothesis, H4)*

iii. What are the determinants of farmer participation in field-based learning platforms and subsequent influence on their use of soil fertility and livestock production intensification technologies? *(Adoption hypothesis, H2)*

iv. What are the food processing and utilization technology options that could be suitable for adoption by the targeted households to improve human nutrition and stimulate increased use SI options? *(Innovation sequencing and SI pathways hypothesis, H4)*

7. Methodology

Project sites

In Year 3, we will maintain and expand activities within the projects sites in Dedza and Ntcheu, which were chosen in Year 2. We have 2 intervention sites in Dedza district: Mposa and Golomoti Sections, located in Linthipe and Golomoti Extension Planning Areas (EPAs), respectively; and also 2 intervention sites in Ntcheu district: Kampanje and Mpamadzi Sections, located in Kandeu and Nsipe EPAs, respectively. Detailed organograms for these sites, that were selected during Years 1 & 2, are presented in Africa RISING Malawi Year 2 proposal. Maize-based production systems dominate for both Ntcheu and Dedza, which have unimodal rainfall and semi-arid to sub-humid tropical agro-ecological zones. The annual rainfall is 700-1100 mm, with distribution occurring from November-April. The majority of farms in these districts are based on hand hoe preparation of land, ranging from 0.5 to 1.5 ha, principally marked by production of crops on raised ridges. Soils are dominated by alfisol types, well drained and generally infertile, often moderately acidic. Texture varies with mollisol types and high clay content in low-lying areas.

Participatory action research and adaptive experimentation

We propose to consolidate on our action 'learning by doing' research approach in the targeted intervention sites, that have now been characterized during Years 1 and 2. Participatory research and modeling will be systematically linked to enhance farmer decision-making, and evaluate performance of 'best bet' SI options for a range of agro-ecologies and farm typologies. We will continue with the educational activities to promote involvement of resource-constrained farmers who often shy away from research and development initiatives.

One of our key intervention and co-learning approaches with farmers involves the use of the 'mother and baby' adaptive trials as platforms for knowledge dissemination. The mother trials are fully replicated experiments with several treatments (see example below), from which farmers are free to choose those options that more appropriately align with their circumstances to try on their own farms - we refer to these as the baby trials. The approach, therefore, presents a basket of options with no assumption of silver bullets, which have proven to be elusive. Mother trials are ideally hosted by lead farmers while hundreds of other farmers experiment with different technologies in their own fields through baby trials.

During Year 3, we propose to have 4 Sections as the 'intervention units' in the EPAs. We will consolidate activities in the 'old' village clusters in which Africa RISING initiated activities during the 2012/13 season, and expand to a 'new' cluster of 4-6 villages (see scheme for Linthipe EPA in Figure 1). Each of these village clusters will host a mother trial and at least 80 baby trials. With this design across the 4 intervention Sections, we anticipate to have 12 'mother trials' and about 960 'baby trial' farmers during the 2013/14 cropping season. Using the intervention–counterfactual experimental design initiated in Year 2, we will progressively assess the level of knowledge gains among farmers in both intervention and counterfactual sites, with disaggregation of data by gender and other household characteristics.

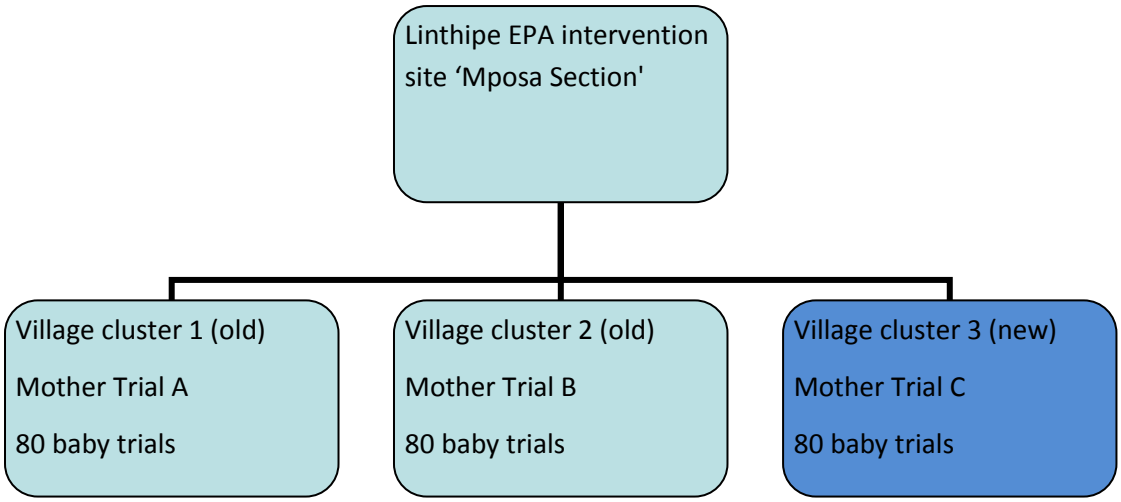


Figure 1. A schematic illustration of action research organization in the intervention sites during the 2013/14 cropping system. A 'section' is the operational unit of extension in an EPA, and it comprises between 10-30 villages

This project builds on insights from past research work on 'best-bet' technologies in Malawi that now need to be refined for 'best-fit'. This is due to the increased recognition of the existence of steep households typology gradients within and across farming communities. The technologies include improved crop varieties and the use of small, targeted quantities of chemical fertilizers and organic inputs whenever these are available, and where required, integrated nutrient and pest management. Participatory work defines current practice, including experimentation by farmers with these sorts of practices, and the relative returns pursued in crop management investments. Direct support for experimentation by farmers helps ensure that we are answering questions they are asking (Snapp et al., 2002). A core principle for all SI options is the diversification of maize based systems with multipurpose grain legumes, such as pigeon pea, cowpea and soybean to enhance fertilizer and water use efficiency (Table 1; Ajayi et al., 2007; Sakala et al., 2000; Snapp et al., 2010). In order to be acceptable, SI best bet options must fit within the resource levels and investment priorities of the target population.

**Table 1**. An example of treatments comprising a mother trial used during Year 2 and modified in Year 3 to include climbing beans. Appropriate crop rotations/sequences will be applied during the 2013/14 and subsequent seasons

| | |
|---|---|
| Sole maize | |
| **1.** | Unfertilized maize – for establishing base yields depending soil resource base<br>(this could be on smaller plots) |
| **2.** | Maize + mineral fertilizers NPKS – for establishing water limited yield potential |
| **3.** | Maize + manure/compost + NPKS – for establishing water limited yield potential with combinations of inorganic -organic nutrient resources |
| Grain legumes and intercrops (could receive P, no more than 10 kg $ha^{-1}$) | |
| **4.** | Sole groundnut |
| **5.** | Sole cowpea or inoculated soybean (for dry or wet agro-ecologies, respectively) |
| **6.** | Sole climbing beans (with appropriate staking) |
| **7.** | Doubled-up legumes: option A (pigeonpea/groundnut intercrop) |
| **8.** | Doubled up legumes: option B (pigeonpea/cowpea or soybean intercrop |
| **9.** | Maize/pigeonpea intercrop |
| **10.** | Maize/common bean intercropping |
| Soil health restoration technologies | |
| **11.** | .. any other options prioritized by farmers |

In line with the Year 2 approach, during Year 3, adaptive 'baby trial' farmers will collectively participate during establishment of the 'mother' trials, and each of them would choose a few treatments from the 'mother' trials for experimentation in their own fields. We anticipate that the 'old' farmers will begin to increase area under SI technologies from the minimum 10 m x 40 m area implemented during Year 2 (for those who had 4 plots of 10 m x 10 m) to at least double the area as farmers can use the retained legume seed other than the new seed from Africa RISING continued investments. A survey will be conducted mid-way during the cropping season to determine the area under different SI technologies on farmers' fields, and data will be disaggregated by categories 'old' and 'new' farmers. This approach will be used to test the extent to which contact time with researchers influences the intensity of technology use.

We will use a combination of the treatments in Table 1 to test performance across farms (fertility gradients), and subsequently investigate potential of the technologies to impact on household food

security and income if implemented at scale. We are also introducing the climbing beans technology, that will also be tested on several farms to evaluate the performance of the difference germplasm available in Malawi. As from Year 3, we anticipate that some 'baby trial' farmers will begin to apply some of these technological options at a scale useful for meaningful farm-level extrapolations to be made.

Exploiting niches for livestock intensification in farming systems

Malawi livestock statistics indicate a people-to-livestock ratio of 14:1 and 4:1 for cattle and goats, respectively, and a ratio of 1 person to 4 chickens (GoM, 2011). The higher numbers for goats and chicken reflect survival of species in changing environmental conditions. Goats in particular are small in size; they can survive on tree leaves unlike cattle and sheep in periods of feed shortage. Goats can also be easily kept under free range, tethered or herded. Under crop-livestock integration, legume crop residues are conserved to strategically supplement goats prior to breeding, in late gestation and early lactation under free range or herding system for local goats in the short term. Goat manure is used in making better quality compost for crop production. Strategic goat supplementation in areas where farmer rear own local goats is a viable and adoptable technology because it offers an opportunity to improve the existing production system without necessarily bringing in other species that may not be compatible with current farming system or agro-ecological conditions.

A crop-livestock farming system allows for spread of risk with changes in climate and diversifies agricultural resources. While the presented statistics show that Malawi has a very low livestock density, we hypothesize that there exists a niche that can be exploited for enhanced productivity in this sector. To that end, we will test methodologies that can help those farmers that own livestock to be more productive. Complementary elements of the system allows for integrated cultivation of crop and livestock feeds, sequential harvesting and use of crops increasing efficiency of productive land and labor with multiple benefits. Livestock products could be the more direct economic products such as meat and milk, but could also be in the form of manure that can be used to reinforce soil fertility and hence productivity of field crops.

ICRAF has a wealth of knowledge on intensification of dairy livestock production through improved fodder technologies. The Animal Science Department at LUANAR has now been co-opted into the project to strengthen the Africa RISING Malawi livestock research component. In both Dedza and Ntcheu, local goat rearing for meat is a viable enterprises. Dedza will particularly offer better environment for dairy oriented production systems. We therefore propose to enhance crop-livestock integration through offering practical and adaptable technologies that add value to the existing practices, including feed formulations based on available fodder and commercial feed concentrates. Considering the small landholdings that farmers have, goats are one of the livestock species that can thrive on limited land and fodder by surviving on tree leaves unlike bigger ruminants which require more feed.

In summary, the Africa RISING Malawi component will be implemented with researchers from different institutions working collectively but with identifiable work packages allocated to institutions based on recognition of relevant institutional expertise.

- **WP0: Project coordination**: To coordinate and support project activities, establish inter-linkages and communication between stakeholders, provide quality assurance of deliverables and report to the IITA and stakeholders (MSU+IITA)

- **WP1: On-farm adaptive agronomic experimentation**: Relying on on-farm experiments, participatory soil resource and evaluation of farmers' practices, and needs, gender-sensitive analysis of the baseline situation and articulation with male and female farmers participating in co-innovation platforms (MSU + LUANAR + CIAT)
- **WP2: Integration of climbing beans**: There is a potential niche to introduce high yielding and protein rich beans in high elevation sites, especially Linthipe and Nsipe sites. CIAT has experience with climbing beans research and the Africa RISING Malawi team will tap into this expertise during Years 3-5 (CIAT + MSU)
- **WP3: Livestock intensification**: Scientists from LUANAR's Animal Science department have agreed to join the project. These scientists will work with ICRAF to get plausible avenues for livestock intensification in a country with very small land holding, a fact that makes the task difficult. Intensification of goat for meat, and smallholder dairy production has already been identified as an entry point (LUANAR + ICRAF). LUANAR has state of the art laboratory equipment that facilitates appropriate analysis of samples, for plant samples and nutrition,to be done locally.
- **WP4: Nutritional status improvement and diversification:** This component will be anchored by the department of nutrition at LUANAR university. A graduate student will be immediately hired to do thesis work in the Africa RISING framework (LUANAR Human Nutrition Department and DAES Nutrition Department)
- **WP5: Dissemination, impact and networking**: Relying on impact and uptake assessment of gender-responsive proposed technologies, aiming at creating new gender-sensitive conditions for the uptake and implementation of SI technologies by smallholder farmers in the target areas (both crop and livestock options), and to reinforce the existing knowledge networks (MSU + IFPRI + DAES + INVC)

Description of activities by work package

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|---|
| WP0: Project coordination |
| Specific objective: To coordinate project activities, establish inter-linkages and communication between partners, provide quality assurance of deliverables and report to IITA |
| Operational objectives:<br>• To ensure achievement of the envisaged project outcomes and results and reporting to IITA within an optimal timeframe<br>• To establish inter-linkages and facilitate information flows between WPs, and communication with stakeholders at large<br>• To ensure the integrity of the results emanating from the various work packages |
| Description of work (activities)<br>• Align with reporting requirements<br>• Ensure inter-linkages, project updates<br>• Organize workshops |
| Expected results<br>• Project team workshop reports at various stages during the life of the project<br>• Half-yearly project technical and financial reports submitted to IITA<br>• Annual technical and financial project reports to IITA |

WP1: On-farm adaptive agronomic experimentation

Specific objectives

- To (re)establish adaptive on-farm mother trials comprised of the crop technologies prioritized by communities (as informed by reflection of Year 2 experiences)
- To facilitate farmer experimentation and co-learning through the baby trial approach

Description of work (activities)

- Multi-location on-farm experiments testing options for sequential use of organic sources and nutrient inputs under different soils, rainfall and land management
- Multi-location on-farm adaptive testing of SI technology options prioritized and designed with communities to restore degraded soils/lands - soil fertility management technologies to be reflective of farmer resource endowments and capabilities
- Implementation of appropriate crop sequences to harness ecological benefits of preceding legume crops in rotation
- Participatory evaluation of technologies through field days and farmer workshops, ...
- Determine the land allocation/crop patterns at field scale as a result of Africa RISING initiatives (based on baseline, midline and endline surveys) (*beyond Year 3*)

Expected results

- At least four preliminary best-fit SI technologies for different agro-ecologies and socio-economic conditions identified
- At least 900 farmers directly participating in project initiatives and at least double this number participate indirectly during the Year 3
- Scientific evidence on the place of SI under farming systems constrained by inherent poor soil fertility and limited levels of inputs by farmers generated
- Marketed-oriented grain legumes production potential for farmers in different typologies determined
- Improved knowledge of farmer assessment of technologies and the adoption process
- Profitability assessed of SI technologies

| WP2: Integration of climbing beans |
| --- |
| Specific objective: To enhance the productivity and adoptability of climbing bean through improved high yield varieties, management practices and staking options |
| Description of work (activities)<br>• Conduct a baseline review of extent of use of climbing bean varieties and management practices, yields, and other benefits in the Africa RISNG action sites<br>• Assess determinants of adoption and marketing of climbing bean varieties<br>• Establish climbing bean variety trials targeting different soil fertility regimes and cropping systems, using a range of staking materials<br>• Assess forage (bean stover) quality from the trials and farmer practices (extends to Years 4-5)<br>• Estimate actual yield and residual benefits to rotational cereal crops |
| Expected results/outputs<br>• Current practices on climbing bean production and marketing documented<br>• High yielding and farmer preferred climbing bean varieties identified and promoted (*beyond Year 3*)<br>• Quantity and quality of climbing beans biomass, and its contribution to livestock intensification and soil fertility improvement determined<br>• Market potential of climbing beans determined |

WP3: Livestock intensification (*integrate with WP 1*)

Objectives:

- To demonstrate the yield potential of selected tree fodder species under smallholder management systems
- To demonstrate the profitability of the smallholder dairy system and goat production based on leaf biomass leaf meal.
- To investigate the potential for enhanced goat production using simple feeding regimes and disease control techniques

Description of work (activities)

- Conduct an inventory of fodder species and areas (e.g. homestead boundaries, pure field stands, intercropped) used for the growing of trees by smallholder dairy and goat farmers in the area.
- Identify and select farmers, capacitate and support them to establish fodder banks for feeding livestock (goats and dairy cows)
- Collect and analyze data (number of trees, area of stands, leaf biomass yield) for farmers involved in tree leaf fodder production for own use or for sale.
- Assess the potential market opportunities for leaf fodder
- Train farmers on farm-based feed preservation, feed formulation and utilization
- Collect milk yield data of cows fed with different feeds (commercial feeds, farmer local feeds, leaf fodder) and conduct an economic analysis of the profitability of the different feeding strategies used by farmers (*beyond Year 3*)

Expected results

- Productivity of different fodder trees species and seed sources under smallholder farming systems determined and suitable/preferred species and seed sources recommended
- Local market potential of leaf fodder determined
- Profitability of smallholder dairy based on leaf fodder, commercial feeds and local farmer practices determined (*beyond Year 3*)
- Increased market participation by farmers in goats and dairy products (*long term*)

WP4: Nutritional status improvement and diversification (*integrate with WP 3*)

Specific objective:

- To evaluate efficacy of different local food processing approaches and nutrition provision through various food crops (micronutrients, calories, proteins)

Description of work (activities)

- Conduct a nutrition baseline study on food consumption patterns among diverse households
- Collect food samples from households for quantification of nutritive value
- Map food calendars from harvest to the next across diverse households
- Provide training on processing and nutritional value of legumes and dairy products to households, including farmer friendly training and reference materials, capturing a wide range of recipes
- Train farmers on appropriate practices on preservation of farm produce (preserve quality, local drying, minimize contamination and losses)
- Conduct community nutrition workshops and open days

Expected results/outputs

- Training and reference materials developed
- At least 50 trainers/lead farmers trained in nutrition and processing of grain legume food products
- Food calendar, budgets and recipes for households in intervention sites documented and alternatives developed (*beyond Year 3*)

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| WP5: Dissemination, impact and networking |
| Specific objectives:<br>• To enhance knowledge and skills of smallholder farmers and partners for decision making in SI across diverse farming systems |
| Description of work (activities)<br>• Promote dissemination of targeted SI technologies through training and capacity development of partners<br>• Develop appropriate extension/dissemination materials for use by stakeholders (extension agencies, lead farmers)<br>• Conduct participatory action research workshops (co-learning processes and space for feedback)<br>• Document and share best-fit technologies/approaches in agro-ecologies, including adoption and adaptation strategies (*beyond Year 3*)<br>• To link with other USAID-funded programs (e.g. INVC) and other initiatives (e.g. N2Africa) with similar goals (*long term*) |
| Expected results<br>• At least 30 mid to high level extension personnel and hundreds of lead farmers trained<br>• At least two participatory action research workshops convened<br>• Technical extension material developed and disseminated through partner networks (*beyond Year 3*) |

8. Expected results/deliverables, quantifiable and to include short term, long term

a) Knowledge of processes associated with rehabilitating soil through sustainable intensification technologies enhanced (*short-term*)

b) Soil fertility improving technologies appropriate to diverse farming households developed (*short-term*)

c) Diets of households significantly improved with increased prominence of protein -rich products based on intensified grain legume production (soyabean, common bean, groundnut) (*long-term*)

d) The role and decision making capacity of women in technology development, evaluation and application increased (*long-term*)

9. Others deliverables to include short and long term

a) Farmers in intervention sites trained on local processing of grain legumes to various nutritious products (*short-term*)
b) Household food utilization and consumption patterns before and after nutrition interventions established (*long-term*)
c) Graduate students from LUANAR and MSU gain valuable insights into farming systems functioning through on-farm research training (*short-term*)
d) Government extension staff trained in various aspects of crop production, including basics of rhizobiology and the doubled-up legume technology (*short-term*)
e) Collaboration and interaction of researchers from research institution and academia improved (*long-term*)
f) At least 3 scientific publications/manuscripts completed (*short-long term*)
g) Presentations on Africa RISING experience made at various international and regional conferences (*short-long term*)

10. Expected outcomes - short, long term

a) Sustainable intensification technologies being used more widely by farmers in the intervention sites, including those that did not directly host trials (*Long-term*)
b) Extension personnel delivering coherent and scientifically sound extension messages, and equipped to train their peers (*Long-term*)
c) Smallholder farmers have local structures for goat health and marketing at community level (*Long-term*)
d) Farmers increasingly becoming food self sufficient, and participating more meaningfully in input and output markets (*Long-term*)

11. Communication and dissemination strategies

a) Farmer feedback meetings/workshops
b) Farmer appraisal meetings for different SI strategies
c) Documentation and sharing experiential learning through success stories
d) Publications and conference papers, including synthesis and recommendations documented through a write shop

e) Policy briefs to the Ministry of Agriculture

f) Working with development partners, e.g. INVC for wider dissemination

## 12. M&E (linking with IFPRI)

Monitoring and evaluation (M&E) ensures that researchers are able to keep track of the impact of the strategies employed and seek redress in time, where necessary. Monitoring tools have already been developed, including:

a) IFPRI has developed a program-wide M&E framework that tracks the implementation of the project and its outcomes. During Year 2, a baseline survey was implemented in all action and counterfactual sites.

b) The Malawi research team has also developed a complementary internal M&E system.

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14. Project activity schedule (summarized, details in log frame)

| Activity | Oct 2013 | Nov 2013 | Dec 2013 | Jan –Feb 2014 | Mar - May 2014 | Jun-Aug 2014 | Sep 2014 |
|---|---|---|---|---|---|---|---|
| Expansion of action sites (including selection of new farmers), nursery establishment for fodder, procurement of inputs, etc | | | | | | | |
| Organize participatory training workshops, distribute seed and other inputs, | | | | | | | |
| Establish adaptive trials (field crops, tree fodder bank experiments) | | | | | | | |
| Conduct targeted baseline nutrition surveys | | | | | | | |
| Field trials evaluations, field days, harvesting | | | | | | | |
| Organize nutrition, livestock beans, etc. workshops; | | | | | | | |
| Feedback workshops/write-shops, data analysis | | | | | | | |
| Annual report writing | | | | | | | |

15. USAID Indicator targets

| Indicator title | Target 2013/14 | 2012/13 achievements | Projection for 2013/14 | Projection for 2014/15 |
|---|---|---|---|---|
| Number of farmers and others who have applied new technologies or management practices as a result of USG assistance | 320 | 451 | 960 | 1500 |
| Number of hectares under improved technologies or management practices as a result of USG assistance | Not set target | 180 ha | 360 ha | 1000 ha |
| Number of individuals who have received USG supported short-term agricultural sector productivity or food security training | No set target | 38 extension, 167 women farmers trained in value addition and nutrition | 500 women farmers trained in value addition and nutrition; 50 extension trained in SI technologies | >1000 women farmers trained in value addition and nutrition |
| Number of new technologies or management practices in one of the following phases of development:<br>…in Phase II: under field testing as a result of USG assistance | | 4 crop SI technologies | 2 SI crop-based technologies<br>2 SI livestock technologies | |

# APPENDIX: Logical Framework

**Title**: Agro-ecological intensification in Malawi through action research with smallholder farmers

| Intervention Logic | Objectively Verifiable Indicators | Sources of Verification | Important assumptions |
|---|---|---|---|
| Overall Objective:<br><br>The main objective of the project is to set up a research approach that systematically assesses best-bet crop and livestock intensification technical options that appropriately respond to the needs of resource-poor farmers - particularly female headed households | | | |
| Purpose:<br><br>To enhance farmer knowledge and support sustainable intensification (SI) pathways for productivity gains in maize-legume diversified systems, that also integrate livestock-related enterprises such as improved fodder for intensified dairy production and goat meat production | • At least 50% of the farmers in the study sites demanding SI information and technologies by the end of the project period<br>• Productivity of cereals and legume crops increased by 20-30% due to use of SI by participating farmers across different resource groups by 2016<br>• At least 30% of farmers in the intervention sites visiting nearest 'mother trials' and | • Monitoring and evaluation reports<br>• Project progress reports and student thesis<br>• Extension worker and district reports | • Normal rainfall seasons and other climate conditions prevail during project period<br>• Inputs are available on the market and current private sector/ agro-dealer driven initiatives continue to operate |

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| | participating in field days and nutrition fares<br>• At least 50% of participating research and extension personnel from both public and private institutions employing participatory approaches in their work with farmers | | |
| Results by Work Package<br><br>• **WP0: Project coordination**: To coordinate and support project activities, establish inter-linkages and communication between stakeholders, provide quality assurance of deliverables and report to the IITA | • Project team workshop reports at various stages during the life of the project<br>• Half-yearly project technical and financial reports submitted to IITA<br>• Annual technical and financial project reports to IITA | • Field assessment reports<br>• Graduate students progress reports<br>• Extension workers' and partner periodic reports<br><br>• [as above]<br>• Technical progress reports for the | • Normal rains are received during both seasons in the study<br><br>• Prevailing economic and socio-political environment remains favorable for consistent stakeholder participation |

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| and stakeholders<br><br>• **WP1: On-farm adaptive agronomic experimentation**: Relying on on-farm experiments, participatory soil resource and evaluation of farmers' practices, and needs, gender-sensitive analysis of the baseline situation and articulation with male and female farmers participating in co-innovation platforms<br><br>• **WP2:** | • A data base on crop responses to different SI options under variable climatic conditions initiated<br>• At least 12 mother trials established jointly by farmers, extension and development partners in each year of the intervention sites<br>• At least 12 farmer action groups participating in participatory action research activities to solve local crop production problems in the study sites by September 2014<br>• At least 900 farmers in the intervention sites participating in the implementatio | project<br>• Journal paper drafts<br>• Project database<br>• Recommendations for SI technologies prepared for Policy drafts and Extension materials<br>• [as above]<br>• [as above] | • [as above]<br>• [as above]<br>• no |

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| **Integration of climbing beans**: Exploiting the existing niches for introducing high yielding and protein rich beans for improved nutrition and soil fertility, in high elevation sites.<br><br>• **WP3: Livestock intensification**: Researchers working towards plausible avenues for livestock intensification : Intensification of goat for meat, and smallholder dairy production as an entry points<br><br>• **WP4:** | n of SI crop-livestock technologies<br>• At least 50% of participating farmers being able to explain reasons for use of named SI technology options<br>• Profitability assessed for 4 SI technologies, including gender aware assessment<br><br>• Current practices on climbing bean production and marketing documented<br>• High yielding and farmer preferred climbing bean varieties identified and promoted<br>• Households calorie and protein consumption enhanced<br>• Demonstrated | • [as above]<br>• recipes used by farmers available<br>• training reports<br>• photographs of processed/ food products<br><br>• training reports<br>• technical bulletins<br>• DVD on SI technologies | livestock disease epidemic |

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| **Nutritional status improvement and diversification:** local level processing of grain legumes into nutritious products by women farmers<br><br>• **WP5: Dissemination, impact and networking**: A combination of new training activities and reinforcement of existing knowledge, and networking with development agencies | increased market participation by households<br><br>• Feeding regimes for cows and goats identified and implemented<br>• Milk yields increases documented<br>• Increased market participation by farmers in goats and dairy products (*long term*)<br><br>• Training and reference materials developed<br>• At least 50 trainers/lead farmers trained in nutrition and processing of grain legume | | |

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| | food products<br>• Food calendar, budgets and recipes for households in intervention sites documented and alternatives developed (*beyond Year 3*)<br>• At least two participatory action research workshops convened<br>• Technical extension material developed and disseminated through partner networks (*beyond Year 3*) | | |

| Activities by work package | Key milestones |
|---|---|
| WP0: Project coordination<br>• Align with reporting requirements<br>• Ensure inter-linkages, project updates<br>• Organize workshops | • Interim financial and technical reports prepaid April 2014<br>• Year 3 technical and financial reports prepared September 2014 |

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| WP1: On-farm adaptive agronomic experimentation<br>• Multi-location on-farm experiments testing options for sequential use of organic sources and nutrient inputs under different soils, rainfall and land management<br>• Multi-location on-farm adaptive testing of SI technology options prioritized and designed with communities to restore degraded soils/lands - soil fertility management technologies to be reflective of farmer resource endowments and capabilities<br>• Implementation of appropriate soil and water conservation practices (e.g. tied ridges, appropriate residue management, etc)<br>• Participatory evaluation of technologies through field days and farmer workshops, ...<br>• Determine the land allocation/crop patterns at field scale as a result of Africa RISING initiatives (based on baseline, midline and endline surveys) (*beyond Year 3*) | • Field experiments established by December 20, 2013<br>• Field days organized between February and March 2013<br>• Nutrition baseline profiling done by March 2014<br>• Yield assessments of climbing beans done by May 2013 |
| WP2: Integration of climbing beans<br>• Conduct a baseline review of extent of use of climbing bean varieties and management practices, yields, and other benefits in the Africa RISNG action sites<br>• Assess determinants of adoption and marketing of climbing bean varieties<br>• Establish climbing bean variety trials targeting different soil fertility regimes and cropping systems, using a range of | • fodder banks established by November 2013<br>• inventory fodder species in action sites by February 2014<br>• farmer training on feed formulation by April 2014<br>• preliminary milk yield assessments by May 2014 |

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| staking materials<br>• Assess forage (bean stover) quality from the trials and farmer practices (extends to Years 4-5)<br>• Estimate actual yield and residual benefits to rotational cereal crops<br><br>WP3: Livestock intensification (*integrate with WP 1*)<br>• Conduct an inventory of fodder species and areas (e.g. homestead boundaries, pure field stands, intercropped) used for the growing of trees by smallholder dairy and goat farmers in the area.<br>• Identify and select farmers, capacitate and support them to establish fodder banks<br>• Collect and analyze data (number of trees, area of stands, leaf biomass yield) for farmers involved in tree leaf fodder production for own use or for sale.<br>• Assess the potential market opportunities for leaf fodder<br>• Train farmers on farm-based feed preservation, feed formulation and utilization<br>• Collect milk yield data of cows fed with different feeds (commercial feeds, farmer local feeds, leaf fodder) and conduct an economic analysis of the profitability of the different feeding strategies used by farmers (*beyond Year 3*)<br><br>WP4: Nutritional status improvement and diversification (*integrate with WP 4*)<br>• Conduct a nutrition baseline study on | • nutrition baseline studu conducted by February 2014<br>• nutrition training and nutrition fares conducted by August 2014<br><br>• DVD material capturing initiated at planting crops (November 2013)<br>• Field workshops with farmers and extension conducted by April 2014 |

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| food consumption patterns<br>• Provide training on processing and nutritional value of legumes and dairy products to households, including farmer friendly training and reference materials, capturing a wide range of recipes<br>• Train farmers on appropriate practices on preservation of farm produce (preserve quality, local drying, minimize contamination and losses)<br>• Conduct community nutrition workshops and open days<br><br>WP5: Dissemination, impact and networking<br>• Promote dissemination of targeted SI technologies through training and capacity development of partners<br>• Develop appropriate extension/dissemination materials for use by stakeholders (extension agencies, lead farmers)<br>• Conduct participatory action research workshops (co-learning processes and space for feedback)<br>• Forge linkages with other initiatives with similar goals (e.g. INVC, N2Africa)<br>• Document and share best-fit technologies/approaches in agro-ecologies, including adoption and adaptation strategies (*beyond Year 3*) | |